

layer on a solid matrix that provides means for supporting the leads. Typically, the solid matrix is a chemically inert, nonconductive substrate, such as a glass or ceramic.

[0035] Sensor arrays of the present invention are particularly well-suited to scaled up production by being fabricated using integrated circuit (IC) design technologies. For example, the chemiresistors can easily be integrated onto the front end of a simple amplifier interfaced to an A/D converter to efficiently feed the data stream directly into a neural network software or hardware analysis section. Micro-fabrication techniques can integrate the chemiresistors directly onto a micro-chip that contains the circuitry for analogue signal conditioning/processing and then data analysis. This provides for the production of millions of incrementally different sensor elements in a single manufacturing step using ink-jet technology. Controlled compositional gradients in the chemiresistor elements of a sensor array can be induced in a method analogous to how a color ink-jet printer deposits and mixes multiple colors. However, in this case, rather than multiple colors, a plurality of different polymers in a solution which can be deposited are used. A sensor array of a million distinct elements only requires a 1 cm×1 cm sized chip employing lithography at the 10 μ m feature level, which is within the capacity of conventional commercial processing and deposition methods. This technology permits the production of sensitive, small-sized, stand-alone chemical sensors,

[0036] The fabrication of the sensors of the present invention involves polarization processing of the conductive material. Suitable polarization processing includes, but is not limited to, magnetic field processing which involves exposure to magnetic fields, photolytic field processing which involves exposure to optical radiation, electric field processing which involves exposure to electric fields, and combinations thereof. In photolytic field processing, light sensitive material can be exposed to optical radiation, such as visible, infrared, or ultraviolet light (see, U.S. Pat. No. 4,737,112). All of the foregoing polarization processing techniques can have different axes direction and different strengths.

[0037] Preferred sensor arrays have a predetermined inter-sensor variation in the structure or composition of the nonconductive regions (e.g. the nonconductive organic material). The variation can be quantitative and/or qualitative. For example, the concentration of the nonconductive organic material in the blend can be varied across sensors. Alternatively, a variety of different alignment techniques are possible within the sensor array. For example, the polarization processing techniques (e.g., magnetic and electric fields) can vary across the array of sensors.

[0038] An electronic nose for detecting an analyte in a fluid is fabricated by electrically coupling the sensor leads of an array of compositionally different sensors to an electrical measuring device. The device measures changes in resistivity at each sensor of the array, preferably simultaneously and preferably over time. Frequently, the device includes signal processing means and is used in conjunction with a computer and data structure for comparing a given response profile to a structure-response profile database for qualitative and quantitative analysis.

[0039] As such, in another embodiment, the present invention, relates to a system for detecting an analyte in a fluid,

comprising: a sensor array comprising first and second sensors wherein the first sensor comprises a region of aligned conducting material. Preferably, the first and second sensors are first and second chemically sensitive resistors, each chemically sensitive resistor comprising a plurality of alternating regions comprising a nonconductive region, such as a nonconductive organic material, and an aligned conductive region, such as an aligned conductive material compositionally different than the nonconductive region. Each resistor provides an electrical path through the alternating nonconducting region and the aligned conductive regions, a first response such as an electrical resistance, when contacted with a first fluid comprising an analyte at a first concentration and a second different response when contacted with a second fluid comprising the analyte at a second different concentration, the difference between the first response and the second response of the first sensor being different from the difference between the first response and the second response of the second sensor under the same conditions; an electrical measuring device electrically connected to the sensor array; and a computer comprising a resident algorithm; the electrical measuring device detecting the first and said second responses in each of the sensors and the computer assembling the responses into a sensor array response profile.

[0040] Typically, such sensor arrays and electronic noses of the present invention comprise at least ten, usually at least 100, and often at least 1000 different sensors, though with mass deposition fabrication techniques described herein or otherwise known in the art, arrays of on the order of at least 10⁶ sensors are readily produced.

[0041] In operation, preferably each resistor provides a first electrical resistance between its conductive leads when the resistor is contacted with a first fluid comprising an analyte at a first concentration, and a second electrical resistance between its conductive leads when the resistor is contacted with a second fluid comprising the same analyte at a second different concentration. The fluids can be liquid or gaseous in nature. The first and second fluids may reflect samples from two different environments, a change in the concentration of an analyte in a fluid sampled at two time points, a sample and a negative control, etc. The sensor array necessarily comprises sensors that respond differently to a change in an analyte concentration, i.e., the difference between the first and second electrical resistance of one sensor is different from the difference between the first and second electrical resistance of another sensor. In addition, the sensor array can comprise redundant sensors that can be advantageous for maximizing the signal and thus reducing the noise in the signal.

[0042] In a preferred embodiment, the temporal response of each sensor (resistance as a function of time) is recorded. The temporal response of each sensor may be normalized to a maximum percent increase and percent decrease in resistance which produces a response pattern associated with the exposure of the analyte. By iterative profiling of known analyses, a structure-function database correlating analyses and response profiles is generated. Unknown analyte can then be characterized or identified using response pattern comparison and recognition algorithms. Accordingly, analyte detection systems comprising sensor arrays, an electrical measuring device for detecting resistance across each chemiresistor, a computer, a data structure of sensor array